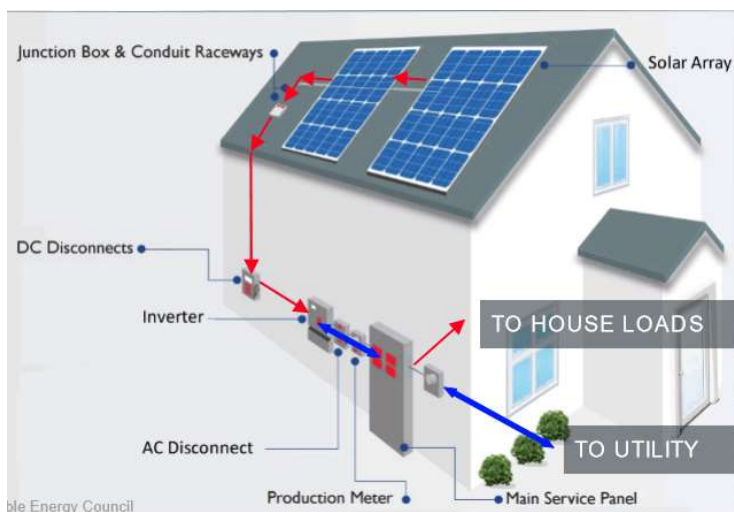


Solar Panels (Grid Tied Systems)

Examples of Photovoltaic systems (P.V. systems) i.e. solar panels. Solar energy systems are systems that are designed to harness solar energy to generate thermal and/or electrical energy through the use of photovoltaic panels and associated components.



EXAMPLE OF GRID-TIED SYSTEM (Connected directly to utility grid, no battery storage)



Photovoltaic systems (PV) or "Solar Panel systems are designed for many functions such as:

- 1). To provide space heating and/or cooling;
- 2). To provide hot water heating;
- 3). To provide swimming pool heating

The code has several requirements for each type of use. This handout is intended to provide some general guidelines.

NOTE: This system is designed to reduce the amount of power required from the utility. Depending on the size of the system the amount of power generated may exceed that of the power demand. When this happens the system will be exporting electricity back to the utility grid. Please contact your utility provider for any questions regarding compensation or benefits that may be provided. The following are links for assistance

Mid American Energy – <https://www.midamericanenergy.com/private-generation.aspx>

Consumers Energy - <https://new.consumersenergy.com/residential/renewable-energy>

This system will not generate power¹ during a power outage unless the system includes a battery backup. Photovoltaic systems will shut off during grid power outages as a safety feature so as not to energize utility electric line that are assumed to be non-energized by utility staff.

¹Even though the system is shut down the panels and their leads (typically 18" in length) have the potential of being energized.

Photovoltaic systems can be designed with a battery backup (UPS system) to operate selected circuits in a building for hours or days during a utility outage. Circuits such as furnace, refrigerator, and/or a general use circuit.

SUBMITTAL REQUIREMENTS

Overview of permit submittal documents

1. Permit application
2. Site plan if panels are not installed on an existing structure
3. Roof system layout plan (site plan not required if system on roof)
4. Structural Engineering documents if on structure
5. Technical Data Sheets of panels, modules, inverter and rack system
6. Electrical schematic plan to include size of wires, types of wires, disconnects, etc.
7. Interconnectivity agreement with electrical utility company ([see above website links](#))
8. Signage requirements



1. Permit Application

An Electrical permit application is required to be submitted along with submittal documents.

A Building permit is required to be submitted if structural changes are needed. The permit application required is for Additions & Alterations (Residential) and can be found at:

<http://www.ankenyiowa.gov/departments/planning-and-building/building-information/permit-applications-guidelines>

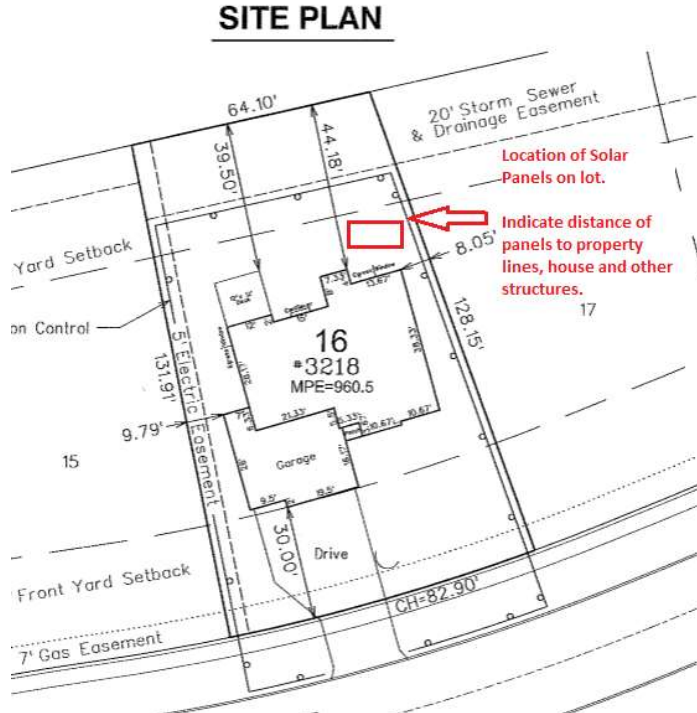
Applications may also be obtained from the following:

Public Safety Building
222 W. 1st Street
Ankeny, Iowa 50023

Staff can also be reached at 515-963-3550



2. Site plan if panels are not installed on an existing structure



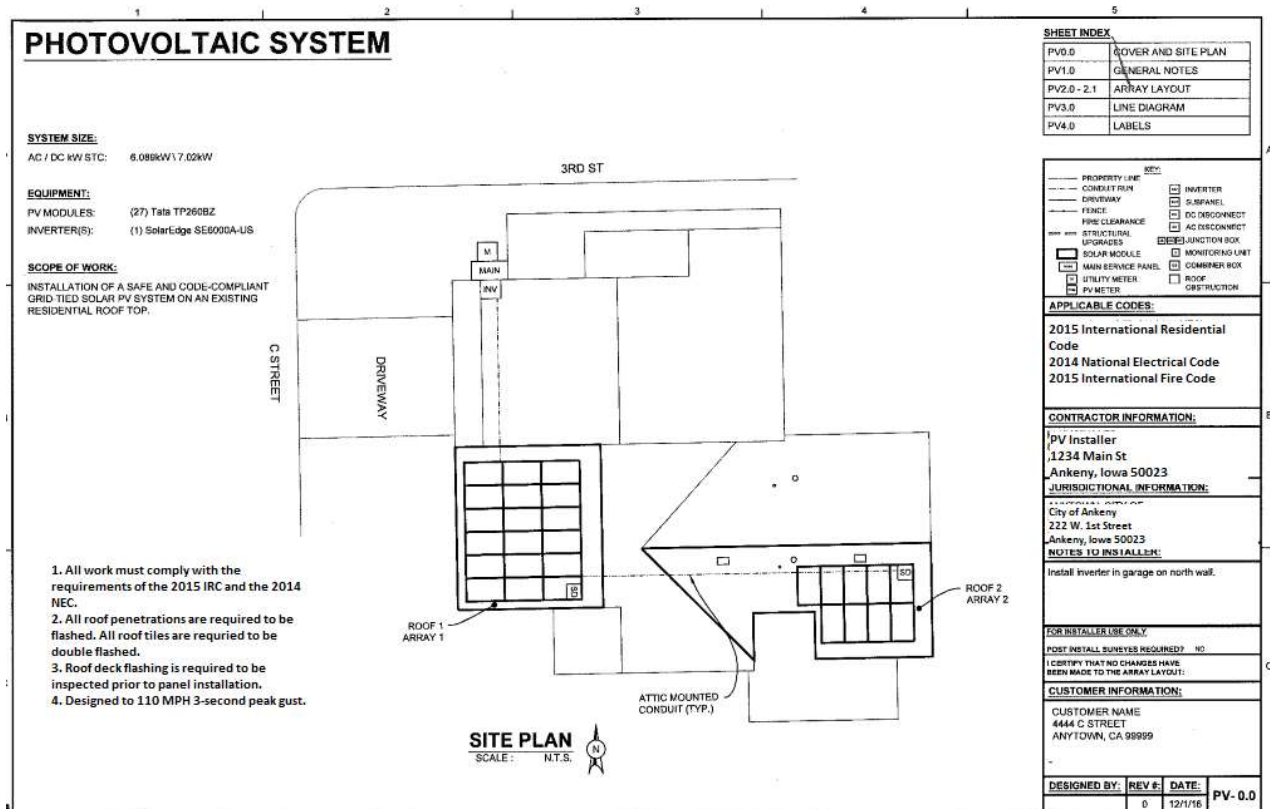
Panels located in a yard are treated as “Accessory” structures for Zoning Code purposes.

This means the panels must be:

- 1) In the rear yard
- 2) Not located in any easements
- 3). Be 3 feet from a property line
- 4). Cannot exceed 12 feet in height
- 5). If on corner lot must conform to the front yard setback regulations on both streets.



3. Roof system layout plan

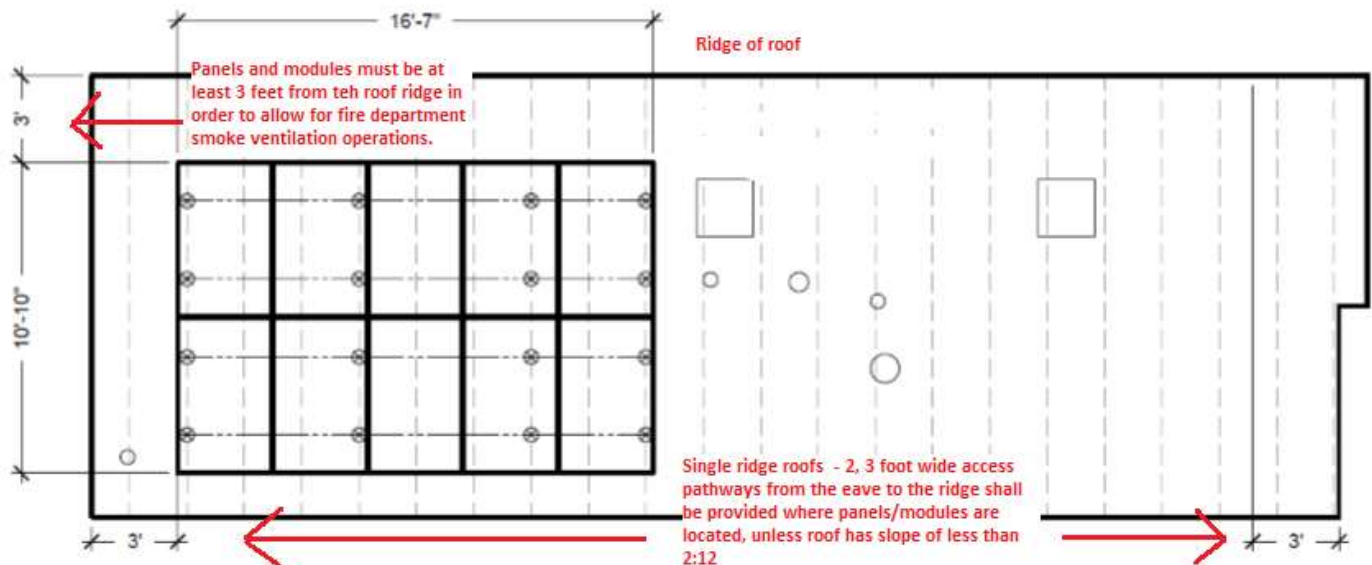


Example of Roof system layout

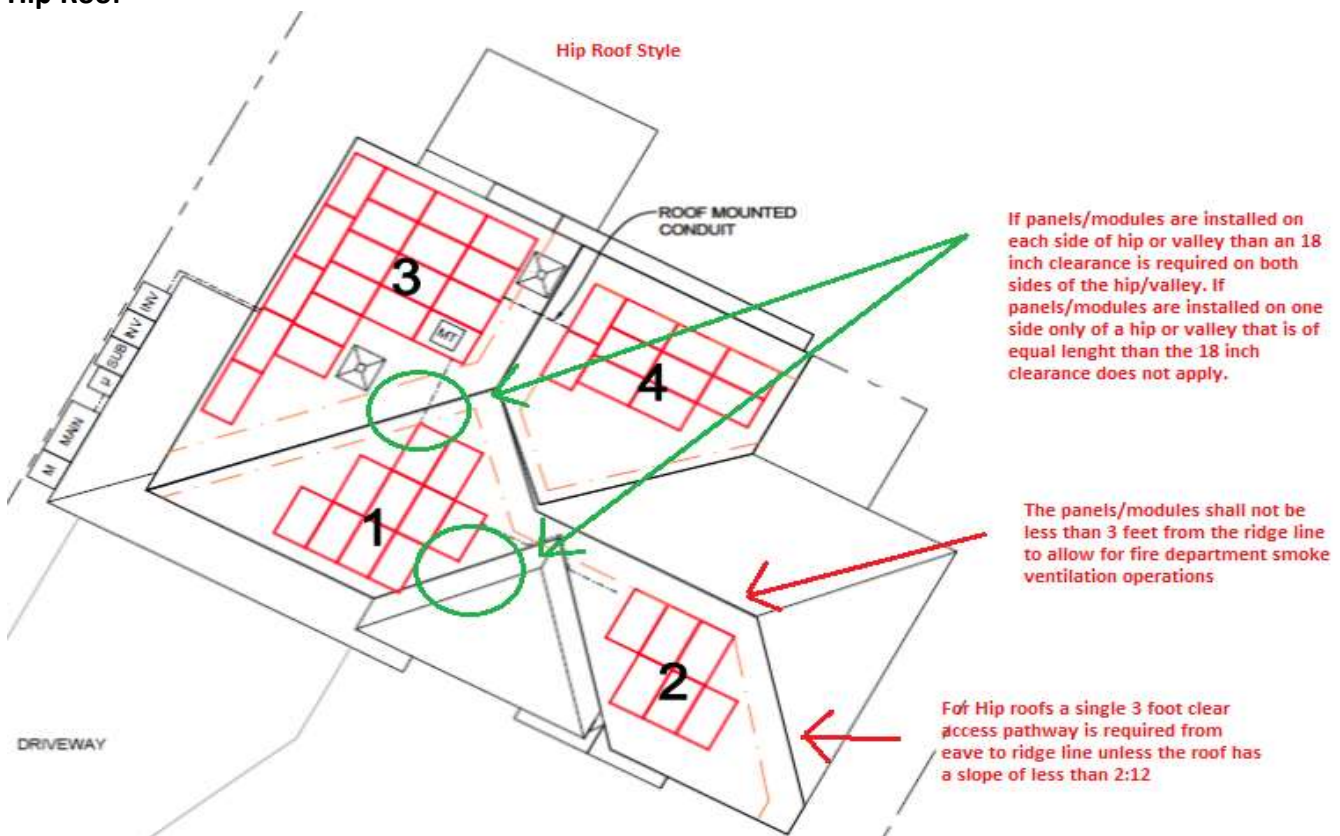
The roof system layout needs to provide the following items:

- A. The location of the solar panels on the actual roof as well as junction boxes and rapid shutdown.
- B. Location of any chimneys, plumbing vents, attic ventilation, peaks, valleys and ridge lines.
- C. Location of Inverter, a/c disconnect, combiner box, dc disconnect, main power disconnect, etc.
- D. Type of roof materials, location of DC or AC wiring (also noting if surface mounted or other method)
- E. Access pathways as required by the IRC (see the following).

Single Ridge Roof



Hip Roof



- NOTE:** 1. Each photovoltaic array is limited to 150 feet by 150 feet. Multiple arrays shall be separated by a clear access pathway not less than 3 feet in width.
2. Roof access points shall be located in areas that do not require the placement of ground ladders over openings such as windows or doors, located at strong points of building construction and where the access point does not conflict with overhead obstructions such as tree limbs, wires and signs.
3. Detached garages and accessory structures to one & two family dwellings are exempt from the access pathway requirements.



4. Structural Engineering

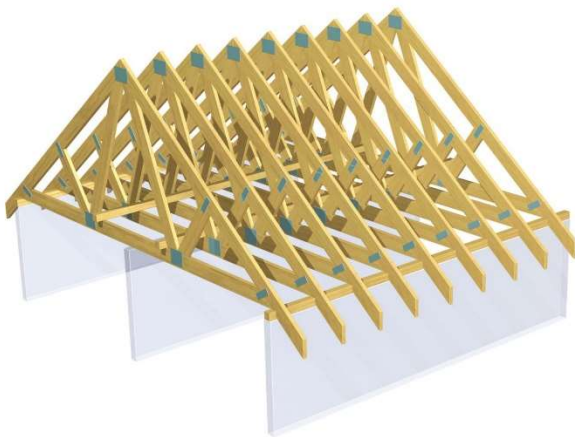
NOTE: A structural engineers report is required to be submitted with the permit application. The existing roof system is required to be analyzed by a licensed professional in order to determine whether or not the existing structure is capable of supporting the increased loads from the solar panel system.



Residential applications typically involve a pitched roof in which solar panels are mounted parallel to the roof pitch. The gravity loads of the solar panels can magnify the uniform loads existing on the roof by concentrating them as point loads. The same holds true for wind loading, as the wind uplift is accumulated through the solar array and directed to the posts that support the solar panel. Also, depending on the roof geometry, the solar panel may act as a sail and catch wind from under the panel, creating very high uplift loads. In some applications, solar panels are put on flat roofs. To achieve higher efficiency, the photovoltaic panels will be posted to the roof such that the panels are at a pitch angled toward the sun. With this geometry, snow can accumulate on the solar array, but can also slide off the panel and create a drift on the low side of the panel. Further, wind can create many different loading scenarios in roof applications.



Yet another concern is that solar panels are often attached to rafters or trusses with lag screws that must land in the center of a 1.5-inch-wide top chord. Depending on the diameter of the connector, a repair may be required due to the section loss of the wood in the top chord. It is highly recommended that all connections of solar panels be made into blocking that is run between trusses, thus avoiding potential damage to the structural integrity of the truss or rafter. This not only prevents the drilling of trusses, but also distributes any point loads between two trusses and decreases the severity of any repairs.



Different types of roof structural systems play a key in how they perform. For instance trusses are different than stick build or I-joists.

Other factors that may need to be taken into account is the number of shingle layers on the roof or the weight of the solar arrays, etc.

2015 IRC Section 802.10.4 states "... Alterations resulting in the addition of load such as HVAC equipment water heater that exceeds the design for the truss shall not be permitted without verification that the truss is capable of supporting additional loading."



5. Technical Data Sheets of Panels, Modules, Inverter and Rack system

LG NeON 2Black

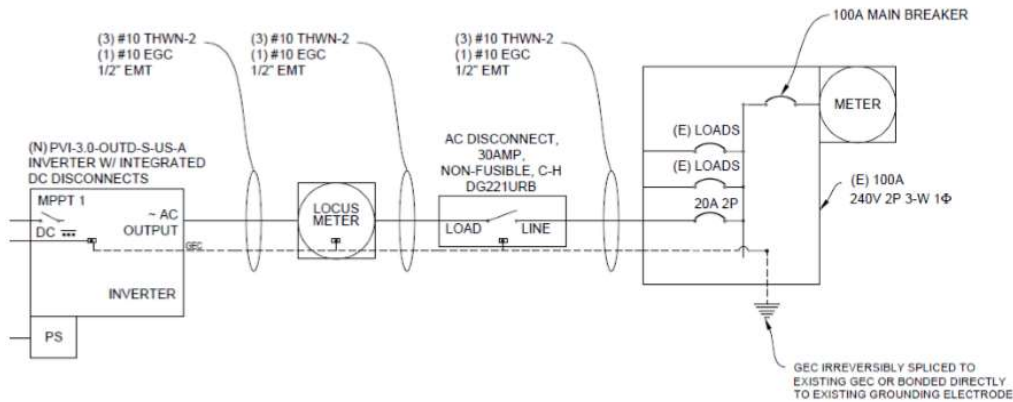
Mechanical Properties	
Cells	6 x 10
Cell Interconnect	1.0
Cell Type	Monocrystalline / Hetero
Cell Dimensions	162.76 x 117.65 mm
Cell Pitch	1.3 (Monocrystalline)
Panel Size (W x H x D)	1440 x 1000 x 40 mm
Panel Weight	10.00 kg
Power Load	1440 W
Weight	11.0 ± 0.1 kg
Connector Type	Genie MC4-EVO
Panel Mounting	MC4-EVO (Genie) / MC4-EVO (Genie) / MC4-EVO (Genie)
Panel Size	1440 x 1000 mm
Panel Weight	11.00 kg
Panel Mounting	High temperature tempered glass
Panel	Positive terminal with protection diode wiring
Electrical Properties (STC)	
Module Type	300 W
Maximum Power (P _{max})	300 W
MPPT Voltage Range (V)	110 V
MPPT Current Range (A)	12.5 A
Open Circuit Voltage (V _{oc})	38.0 V
Short Circuit Current (I _{sc})	9.5 A
Module Efficiency (%)	19.5
Operating Temperature (°C)	-40 ~ +85
Maximum System Voltage (V)	1500
Maximum System Power (W)	3000
Panel Dimensions (mm)	1440 x 1000 x 40
Electrical Properties (NOCT)	
Module Type	300 W
Maximum Power (P _{max})	275 W
MPPT Voltage Range (V)	110 V
MPPT Current Range (A)	12.5 A
Open Circuit Voltage (V _{oc})	38.0 V
Short Circuit Current (I _{sc})	9.5 A
Module Efficiency (%)	19.5
Operating Temperature (°C)	-40 ~ +85
Maximum System Voltage (V)	1500
Maximum System Power (W)	3000
Panel Dimensions (mm)	1440 x 1000 x 40
Panel Weight (kg)	11.0
Panel Mounting	High temperature tempered glass
Panel	Positive terminal with protection diode wiring
Certifications and Warranty	
ISO 9001	Yes
ISO 14001	Yes
CE	Yes
UL	Yes
IEC 61215	Yes
IEC 61730	Yes
UL 1709	Yes
UL 1703	Yes
UL 1704	Yes
UL 1705	Yes
UL 1706	Yes
UL 1707	Yes
UL 1708	Yes
UL 1709	Yes
UL 1710	Yes
UL 1711	Yes
UL 1712	Yes
UL 1713	Yes
UL 1714	Yes
UL 1715	Yes
UL 1716	Yes
UL 1717	Yes
UL 1718	Yes
UL 1719	Yes
UL 1720	Yes
UL 1721	Yes
UL 1722	Yes
UL 1723	Yes
UL 1724	Yes
UL 1725	Yes
UL 1726	Yes
UL 1727	Yes
UL 1728	Yes
UL 1729	Yes
UL 1730	Yes
UL 1731	Yes
UL 1732	Yes
UL 1733	Yes
UL 1734	Yes
UL 1735	Yes
UL 1736	Yes
UL 1737	Yes
UL 1738	Yes
UL 1739	Yes
UL 1740	Yes
UL 1741	Yes
UL 1742	Yes
UL 1743	Yes
UL 1744	Yes
UL 1745	Yes
UL 1746	Yes
UL 1747	Yes
UL 1748	Yes
UL 1749	Yes
UL 1750	Yes
UL 1751	Yes
UL 1752	Yes
UL 1753	Yes
UL 1754	Yes
UL 1755	Yes
UL 1756	Yes
UL 1757	Yes
UL 1758	Yes
UL 1759	Yes
UL 1760	Yes
UL 1761	Yes
UL 1762	Yes
UL 1763	Yes
UL 1764	Yes
UL 1765	Yes
UL 1766	Yes
UL 1767	Yes
UL 1768	Yes
UL 1769	Yes
UL 1770	Yes
UL 1771	Yes
UL 1772	Yes
UL 1773	Yes
UL 1774	Yes
UL 1775	Yes
UL 1776	Yes
UL 1777	Yes
UL 1778	Yes
UL 1779	Yes
UL 1780	Yes
UL 1781	Yes
UL 1782	Yes
UL 1783	Yes
UL 1784	Yes
UL 1785	Yes
UL 1786	Yes
UL 1787	Yes
UL 1788	Yes
UL 1789	Yes
UL 1790	Yes
UL 1791	Yes
UL 1792	Yes
UL 1793	Yes
UL 1794	Yes
UL 1795	Yes
UL 1796	Yes
UL 1797	Yes
UL 1798	Yes
UL 1799	Yes
UL 1800	Yes
UL 1801	Yes
UL 1802	Yes
UL 1803	Yes
UL 1804	Yes
UL 1805	Yes
UL 1806	Yes
UL 1807	Yes
UL 1808	Yes
UL 1809	Yes
UL 1810	Yes
UL 1811	Yes
UL 1812	Yes
UL 1813	Yes
UL 1814	Yes
UL 1815	Yes
UL 1816	Yes
UL 1817	Yes
UL 1818	Yes
UL 1819	Yes
UL 1820	Yes
UL 1821	Yes
UL 1822	Yes
UL 1823	Yes
UL 1824	Yes
UL 1825	Yes
UL 1826	Yes
UL 1827	Yes
UL 1828	Yes
UL 1829	Yes
UL 1830	Yes
UL 1831	Yes
UL 1832	Yes
UL 1833	Yes
UL 1834	Yes
UL 1835	Yes
UL 1836	Yes
UL 1837	Yes
UL 1838	Yes
UL 1839	Yes
UL 1840	Yes
UL 1841	Yes
UL 1842	Yes
UL 1843	Yes
UL 1844	Yes
UL 1845	Yes
UL 1846	Yes
UL 1847	Yes
UL 1848	Yes
UL 1849	Yes
UL 1850	Yes
UL 1851	Yes
UL 1852	Yes
UL 1853	Yes
UL 1854	Yes
UL 1855	Yes
UL 1856	Yes
UL 1857	Yes
UL 1858	Yes
UL 1859	Yes
UL 1860	Yes
UL 1861	Yes
UL 1862	Yes
UL 1863	Yes
UL 1864	Yes
UL 1865	Yes
UL 1866	Yes
UL 1867	Yes
UL 1868	Yes
UL 1869	Yes
UL 1870	Yes
UL 1871	Yes
UL 1872	Yes
UL 1873	Yes
UL 1874	Yes
UL 1875	Yes
UL 1876	Yes
UL 1877	Yes
UL 1878	Yes
UL 1879	Yes
UL 1880	Yes
UL 1881	Yes
UL 1882	Yes
UL 1883	Yes
UL 1884	Yes
UL 1885	Yes
UL 1886	Yes
UL 1887	Yes
UL 1888	Yes
UL 1889	Yes
UL 1890	Yes
UL 1891	Yes
UL 1892	Yes
UL 1893	Yes
UL 1894	Yes
UL 1895	Yes
UL 1896	Yes
UL 1897	Yes
UL 1898	Yes
UL 1899	Yes
UL 1900	Yes
UL 1901	Yes
UL 1902	Yes
UL 1903	Yes
UL 1904	Yes
UL 1905	Yes
UL 1906	Yes
UL 1907	Yes
UL 1908	Yes
UL 1909	Yes
UL 1910	Yes
UL 1911	Yes
UL 1912	Yes
UL 1913	Yes
UL 1914	Yes
UL 1915	Yes
UL 1916	Yes
UL 1917	Yes
UL 1918	Yes
UL 1919	Yes
UL 1920	Yes
UL 1921	Yes
UL 1922	Yes
UL 1923	Yes
UL 1924	Yes
UL 1925	Yes
UL 1926	Yes
UL 1927	Yes
UL 1928	Yes
UL 1929	Yes
UL 1930	Yes
UL 1931	Yes
UL 1932	Yes
UL 1933	Yes
UL 1934	Yes
UL 1935	Yes
UL 1936	Yes
UL 1937	Yes
UL 1938	Yes
UL 1939	Yes
UL 1940	Yes
UL 1941	Yes
UL 1942	Yes
UL 1943	Yes
UL 1944	Yes
UL 1945	Yes
UL 1946	Yes
UL 1947	Yes
UL 1948	Yes
UL 1949	Yes
UL 1950	Yes
UL 1951	Yes
UL 1952	Yes
UL 1953	Yes
UL 1954	Yes
UL 1955	Yes
UL 1956	Yes
UL 1957	Yes
UL 1958	Yes
UL 1959	Yes
UL 1960	Yes
UL 1961	Yes
UL 1962	Yes
UL 1963	Yes
UL 1964	Yes
UL 1965	Yes
UL 1966	Yes
UL 1967	Yes
UL 1968	Yes
UL 1969	Yes
UL 1970	Yes
UL 1971	Yes
UL 1972	Yes
UL 1973	Yes
UL 1974	Yes
UL 1975	Yes
UL 1976	Yes
UL 1977	Yes
UL 1978	Yes
UL 1979	Yes
UL 1980	Yes
UL 1981	Yes
UL 1982	Yes
UL 1983	Yes
UL 1984	Yes
UL 1985	Yes
UL 1986	Yes
UL 1987	Yes
UL 1988	Yes
UL 1989	Yes
UL 1990	Yes
UL 1991	Yes
UL 1992	Yes
UL 1993	Yes
UL 1994	Yes
UL 1995	Yes
UL 1996	Yes
UL 1997	Yes
UL 1998	Yes
UL 1999	Yes
UL 2000	Yes
UL 2001	Yes
UL 2002	Yes
UL 2003	Yes
UL 2004	Yes
UL 2005	Yes
UL 2006	Yes
UL 2007	Yes
UL 2008	Yes
UL 2009	Yes
UL 2010	Yes
UL 2011	Yes
UL 2012	Yes
UL 2013	Yes
UL 2014	Yes
UL 2015	Yes
UL 2016	Yes
UL 2017	Yes
UL 2018	Yes
UL 2019	Yes
UL 2020	Yes
UL 2021	Yes
UL 2022	Yes
UL 2023	Yes
UL 2024	Yes
UL 2025	Yes
UL 2026	Yes
UL 2027	Yes
UL 2028	Yes
UL 2029	Yes
UL 2030	Yes
UL 2031	Yes
UL 2032	Yes
UL 2033	Yes
UL 2034	Yes
UL 2035	Yes
UL 2036	Yes
UL 2037	Yes
UL 2038	Yes
UL 2039	Yes
UL 2040	Yes
UL 2041	Yes
UL 2042	Yes
UL 2043	Yes
UL 2044	Yes
UL 2045	Yes
UL 2046	Yes
UL 2047	Yes
UL 2048	Yes
UL 2049	Yes
UL 2050	Yes
UL 2051	Yes
UL 2052	Yes
UL 2053	Yes
UL 2054	Yes
UL 2055	Yes
UL 2056	Yes
UL 2057	Yes
UL 2058	Yes
UL 2059	Yes
UL 2060	Yes
UL 2061	Yes
UL 2062	Yes
UL 2063	Yes
UL 2064	Yes
UL 2065	Yes
UL 2066	Yes
UL 2067	Yes
UL 2068	Yes
UL 2069	Yes
UL 2070	Yes
UL 2071	Yes
UL 2072	Yes
UL 2073	Yes
UL 2074	Yes
UL 2075	Yes
UL 2076	Yes
UL 2077	Yes
UL 2078	Yes
UL 2079	Yes
UL 2080	Yes
UL 2081	Yes
UL 2082	Yes
UL 2083	Yes
UL 2084	Yes
UL 2085	Yes
UL 2086	Yes
UL 2087	Yes
UL 2088	Yes
UL 2089	Yes
UL 2090	Yes
UL 2091	Yes
UL 2092	Yes
UL 2093	Yes
UL 2094	Yes
UL 2095	Yes
UL 2096	Yes
UL 2097	Yes
UL 2098	Yes
UL 2099	Yes
UL 2100	Yes
UL 2101	Yes
UL 2102	Yes
UL 2103	Yes
UL 2104	Yes
UL 2105	Yes
UL 2106	Yes
UL 2107	Yes
UL 2108	Yes
UL 2109	Yes
UL 2110	Yes
UL 2111	Yes
UL 2112	Yes
UL 2113	Yes
UL 2114	Yes
UL 2115	Yes
UL 2116	Yes
UL 2117	Yes
UL 2118	Yes
UL 2119	Yes
UL 2120	Yes
UL 2121	Yes
UL 2122	Yes
UL 2123	Yes
UL 2124	Yes
UL 2125	Yes
UL 2126	Yes
UL 2127	Yes
UL 2128	Yes
UL 2129	Yes
UL 2130	Yes
UL 2131	Yes
UL 2132	Yes
UL 2133	Yes
UL 2134	Yes
UL 2135	Yes
UL 2136	Yes
UL 2137	Yes
UL 2138	Yes
UL 2139	Yes
UL 2140	Yes
UL 2141	Yes
UL 2142	Yes
UL 2143	Yes
UL 2144	Yes
UL 2145	Yes
UL 2146	Yes
UL 2147	Yes
UL 2148	Yes
UL 2149	Yes
UL 2150	Yes
UL 2151	Yes
UL 2152	Yes
UL 2153	Yes
UL 2154	Yes
UL 2155	Yes
UL 2156	Yes
UL 2157	Yes
UL 2158	Yes
UL 2159	Yes
UL 2160	Yes
UL 2161	Yes
UL 2162	Yes
UL 2163	Yes
UL 2164	Yes
UL 2165	Yes
UL 2166	Yes
UL 2167	Yes
UL 2168	Yes
UL 2169	Yes
UL 2170	Yes
UL 2171	Yes
UL 2172	Yes
UL 2173	Yes
UL 2174	Yes
UL 2175	Yes
UL 2176	Yes
UL 2177	Yes
UL 2178	Yes
UL 2179	Yes
UL 2180	Yes
UL 2181	Yes
UL 2182	Yes
UL 2183	Yes
UL 2184	Yes
UL 2185	Yes
UL 2186	Yes
UL 2187	Yes
UL 2188	Yes
UL 2189	Yes
UL 2190	Yes
UL 2191	Yes
UL 2192	Yes
UL 2193	Yes
UL 2194	Yes
UL 2195	Yes
UL 2196	Yes
UL 2197	Yes
UL 2198	Yes
UL 2199	Yes
UL 2200	Yes
UL 2201	Yes
UL 2202	Yes
UL 2203	Yes
UL 2204	Yes
UL 2205	Yes
UL 2206	Yes
UL 2207	Yes
UL 2208	Yes
UL 2209	Yes
UL 2210	Yes
UL 2211	Yes
UL 2212	Yes
UL 2213	Yes
UL 2214	Yes
UL 2215	Yes
UL 2216	Yes
UL 2217	Yes
UL 2218	Yes
UL 2219	Yes
UL 2220	Yes
UL 2221	Yes
UL 2222	Yes
UL 2223	Yes



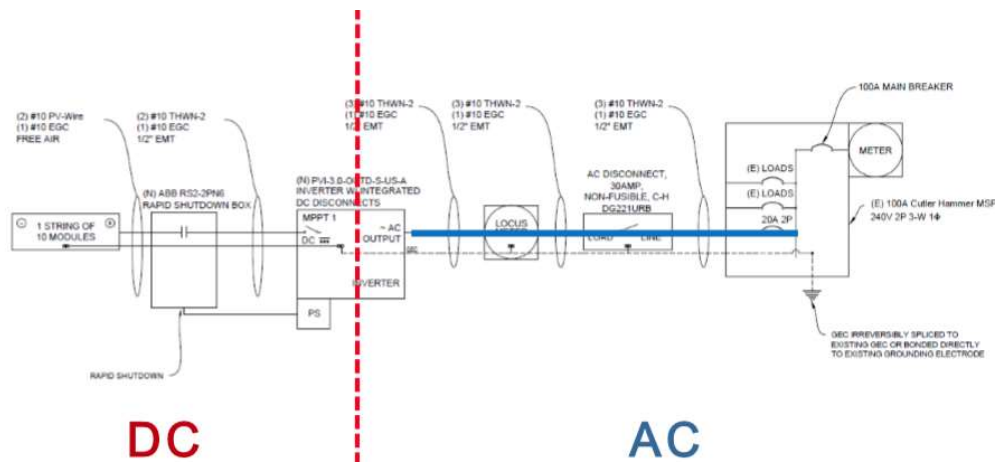
6. Electrical schematic plan to include size of wires, disconnect, types of wires, list of all equipment and components and manufacturers cut sheets of equipment/components.



A State of Iowa Licensed Electrician is required to obtain the electrical permit and perform the installation. The information provided does not reflect all code related items or requirements. The following is just a generic example with some key notes.



Example of Line diagram



Example of Line diagram

USE-2 Wire is allowed to be used however if the inverter is a transformerless inverter than PV wire must be used

GENERIC BASIC NOTES:

- The modules and rack are required to be bonded. Two methods are allowed:
 - Use the rack to ground/bond the modules
 - Use an Equipment grounding conductor to ground/bond the modules
- The module/rack assembly must be listed for bonding per UL 2703, if using method A
- The equipment grounding conductor being used is connected to the modules/rack per the manufacturer's installation instructions.
- If racking system does not meet UL 2703 then each splice is required to be bonded together.
- If racking system is not used for bonding purposes then each module must be bonded via an Equipment Grounding Conductor or other approved method.
- Grounding Electrode Conductor must be irreversibly spliced to existing grounding electrode conductor or bonded directly to existing grounding electrode from the Inverter to the main disconnect.



7. Interconnectivity agreement with utility company

A copy of the connectivity agreement between the utility company and the property owner is required to be provided at the time of permit submittal.

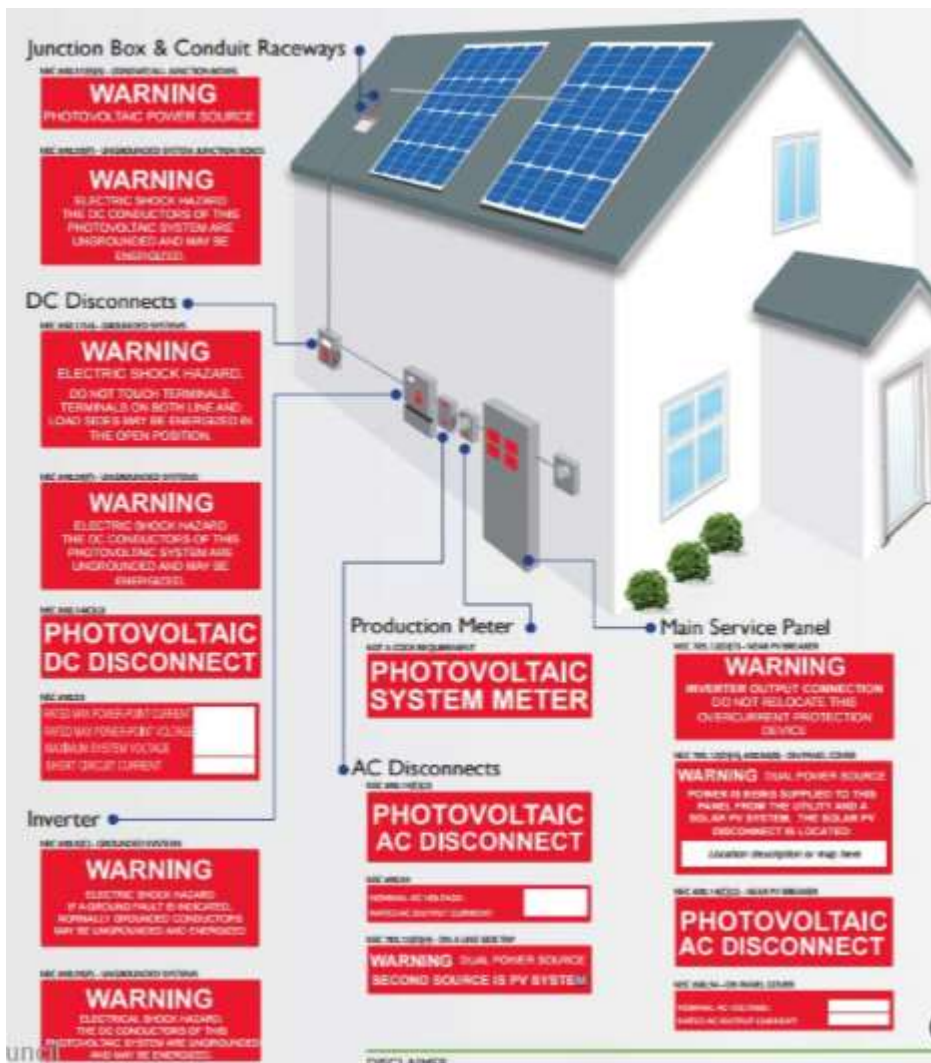
Information and contact information regarding the agreements can be found at:

Mid American Energy – <https://www.midamericanenergy.com/private-generation.aspx>

Consumers Energy - <https://new.consumersenergy.com/residential/renewable-energy>



8. Signage requirements



Signage is required to be installed at:

1. Junction boxes
2. Conduit raceways
3. DC disconnects
4. Inverter
5. AC disconnects
6. Main Service panel
7. Production meter

Please refer to NEC Articles 690 & 705 for signage requirements

This handout is to serve as a guide to what the basic requirements are for PV systems. This handout does not cover all code related items. Each structure is reviewed separately and may require additional items depending on site and structure conditions.